

RECOMMENDATION ITU-R S.521-4

**HYPOTHETICAL REFERENCE DIGITAL PATHS FOR SYSTEMS USING
DIGITAL TRANSMISSION IN THE FIXED-SATELLITE SERVICE**

(1978-1982-1986-1997-2000)

The ITU Radiocommunication Assembly,

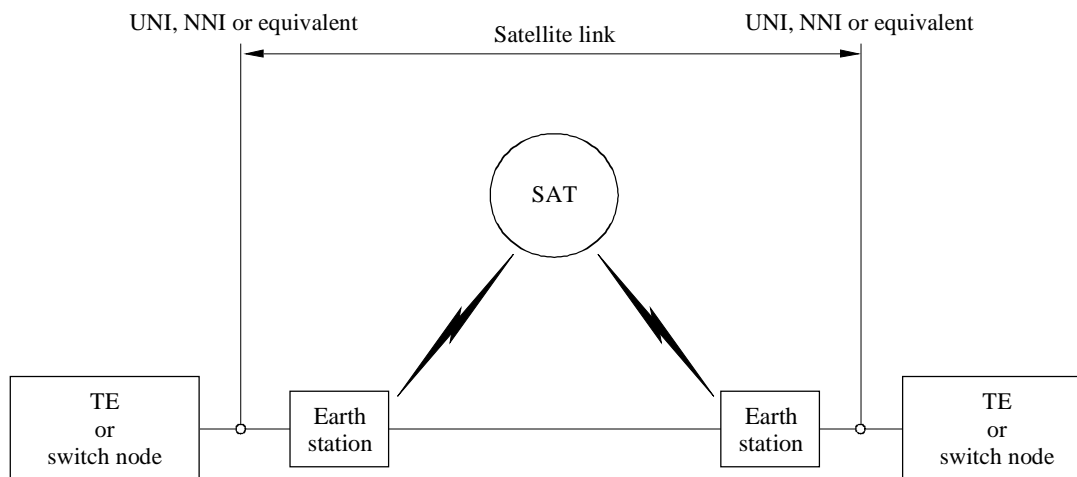
considering

- a) that it is desirable to establish hypothetical reference digital paths (HRDPs) for active fixed-satellite systems to afford guidance to designers of equipment and systems for use in networks employing digital transmission techniques;
- b) that satellite-to-satellite links may be used in the fixed-satellite service (FSS);
- c) that both geostationary and non-geostationary-satellite systems will be part of the FSS;
- d) that some satellite systems include:
 - on-board processing with regeneration,
 - on-board processing with regeneration and switching on the satellite;
- e) that the transmission delay variation introduced by satellite movement is of significance in some applications but the buildout of such delay variations to their worst case to provide constant delay is outside the scope of this Recommendation;
- f) that a FSS HRDP may form part of a hypothetical reference connection (HRX) as defined by ITU-T Recommendation G.801, Fig. 1;
- g) that satellite links may appear in the local, national, or international portion and combinations of two or more contiguous portions of a HRX;
- h) that inter-satellite links (ISLs) among geostationary satellites and non-geostationary satellites may be part of a single HRX;
- j) that a HRDP may include one or more intermediate space-to-Earth and Earth-to-space segments;
- k) that a HRDP may be independent of connections to the terrestrial network,

recommends

- 1** that a generic HRDP shown in Fig. 1 should be used to describe satellite connections which may or may not be connected to terrestrial networks;
- 2** that a HRDP for systems in the FSS should consist of one or more Earth-space-Earth links, whose space portion may comprise one or more ISL;
- 3** that the example HRDPs shown in Annex 1 can be used to describe satellite connections. These Figures show more than one satellite, but in each case there may be only one satellite;
- 4** that links between the earth stations and their associated terrestrial digital switching centres should be considered as part of the terrestrial network and should not be included in the HRDP;
- 5** that for site diversity earth stations, the HRDP should also include the terrestrial links and any associated equipment necessary for connecting the diversity earth stations to the diversity switching point;
- 6** that the HRDP includes RF/IF, demodulation/modulation, error correction, buffer, processing, and multiplex/demultiplex equipment at the customer terminal or earth station;
- 7** that terminal equipment or switch nodes may interface a HRDP at any bit rate.

FIGURE 1
Generic HRDP



SAT: space stations in the FSS, or space station in the service interconnected by satellite-to-satellite links

NNI: network-node interface

UNI: user-network interface

TE: terminal equipment

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NOTE 1 – For satellite networks where earth station processing is integrated with dynamic allocation and rearrangement of capacity across the satellite link, the equipment to perform that processing should be regarded as part of the satellite HRDP. This processing may also include functions for:

- efficient use of satellite bandwidth,
- performance improvement,
- service capabilities peculiar to the satellite system.

NOTE 2 – Customer terminal equipment which would be required to support the particular service(s) being offered regardless of the transmission medium it is connected to is assumed to be outside the satellite HRDP.

NOTE 3 – The HRDP considered in this Recommendation applies to public networks only. Network operators may use these HRDPs for their private networks.

NOTE 4 – The HRDP in this Recommendation is not limited to point-to-point services but may be used for multipoint and asymmetric services.

NOTE 5 – The need for additional HRDP examples to encompass the range of new digital satellite systems is for further study.

NOTE 6 – This Recommendation does not address allocation of performance objectives to the HRDPs. It is recognized however that the same HRDP may be used to represent different satellite system configurations (e.g. on-board processing, earth station processing, non-processing transponder, ISL) which may require different performance allocations.

NOTE 7 – This Recommendation does not apply for end-to-end links in the BSS.

ANNEX 1

The example HRDPs shown in Figs. 2 to 6 can be used to describe satellite connections. These Figures show more than one satellite, but in each case there may be only one satellite. The terminologies used in the Figures are shown below:

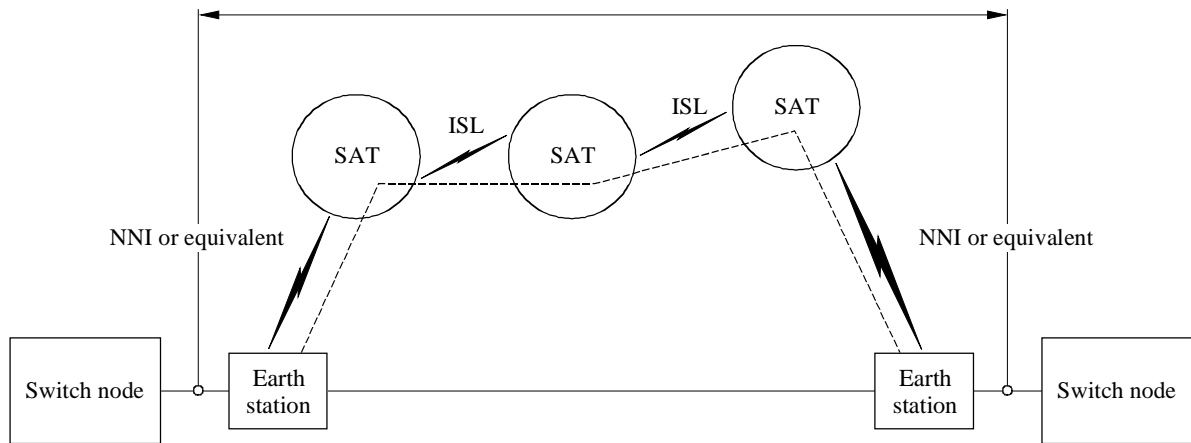
- UNI: user-network interface;
- NNI: network-node interface;

- SAT: satellite station (including on-board processing/switching if used);
- TE: terminal equipment (including processing, multiplex equipment, interfaces to earth station).

Earth station includes RF/IF, modulation/demodulation, error correction, buffer, processing, multiplex/demultiplex equipment and interfaces to terrestrial networks.

Figure 2 describes a HRDP which may be in the national or international portion of a HRX, with connections to the terrestrial network at both ends.

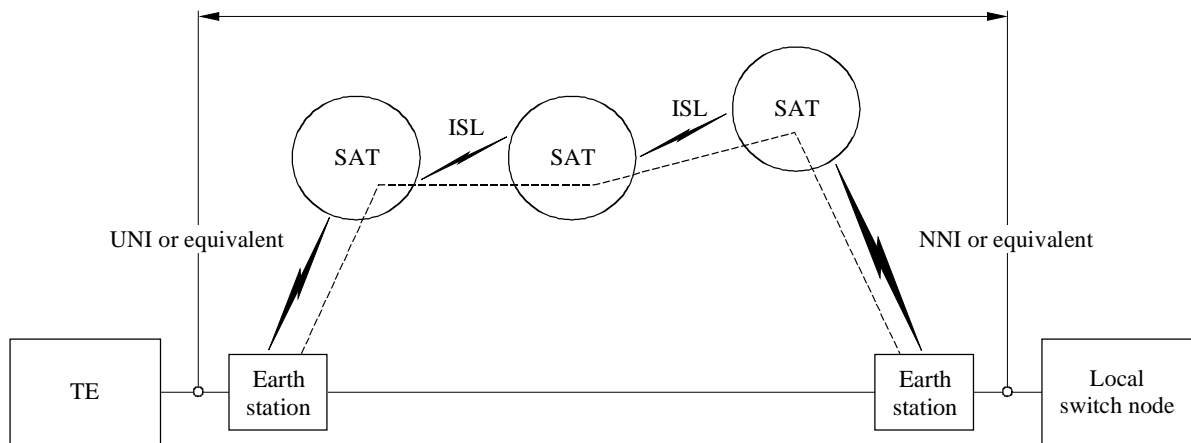
FIGURE 2
Satellite HRDP
 (with connections to the terrestrial network of both ends)



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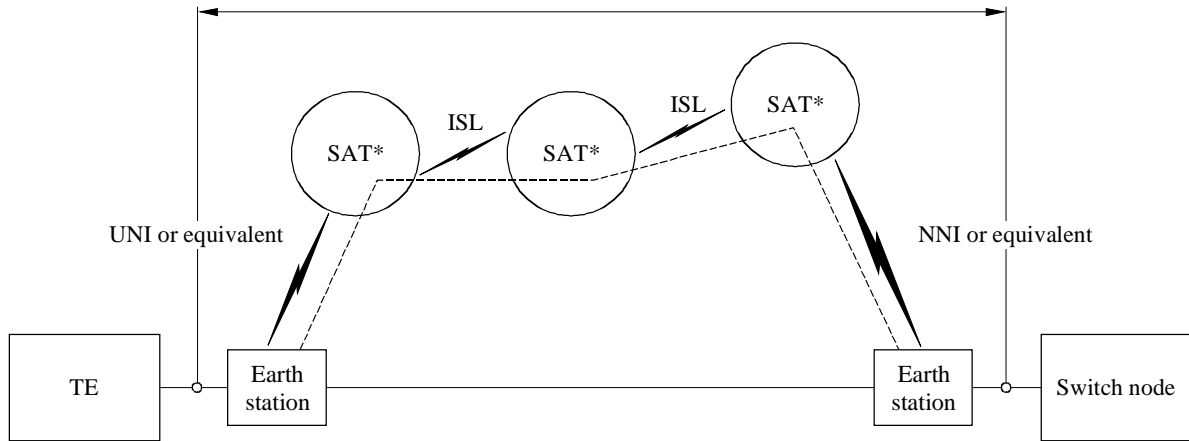
Figures 3 and 4 describe HRDPs which form part of a HRX, with connection to the terrestrial network. It includes a local portion to the customer terminal. The HRDP may be in the domestic or international portion.

FIGURE 3
Satellite HRDP
 (with connection to the terrestrial network at one end)



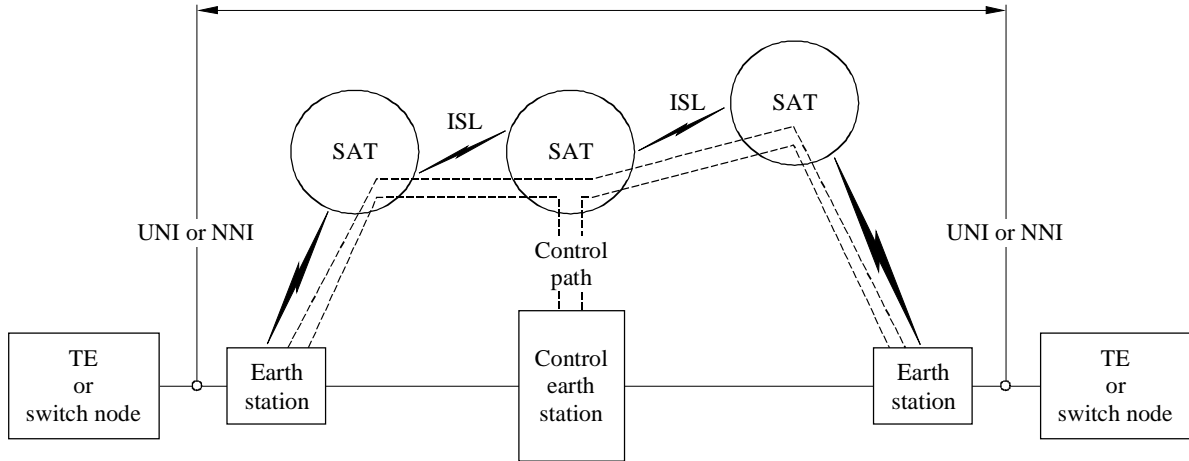
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FIGURE 4
Satellite HRDP



*SAT includes on-board processing/switching.

a) With connection to the terrestrial network at one end, and with on-board processing/switching satellite



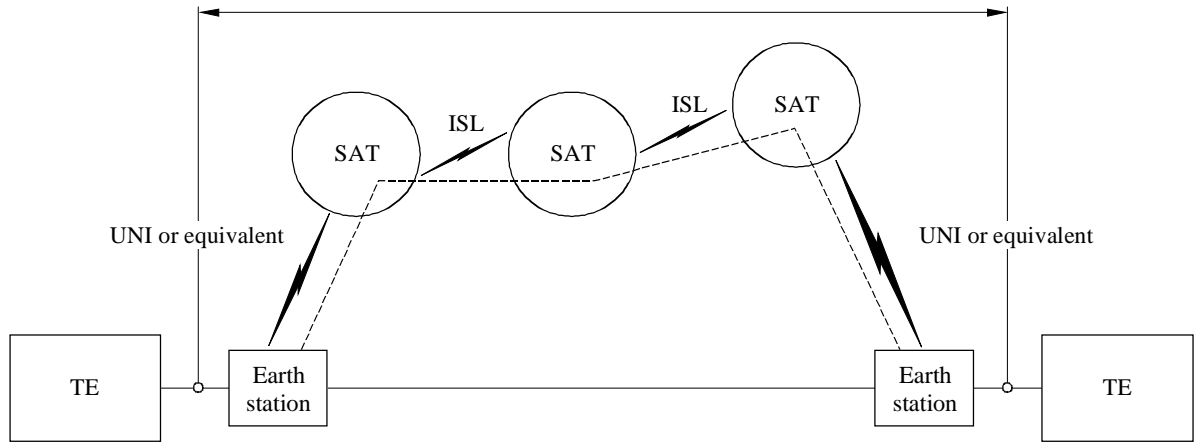
b) Including control path

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Figure 4b) describes a HRDP including a control path associated with a control earth station that is part of the satellite network.

Figure 5 describes a HRDP which does not connect to the terrestrial network.

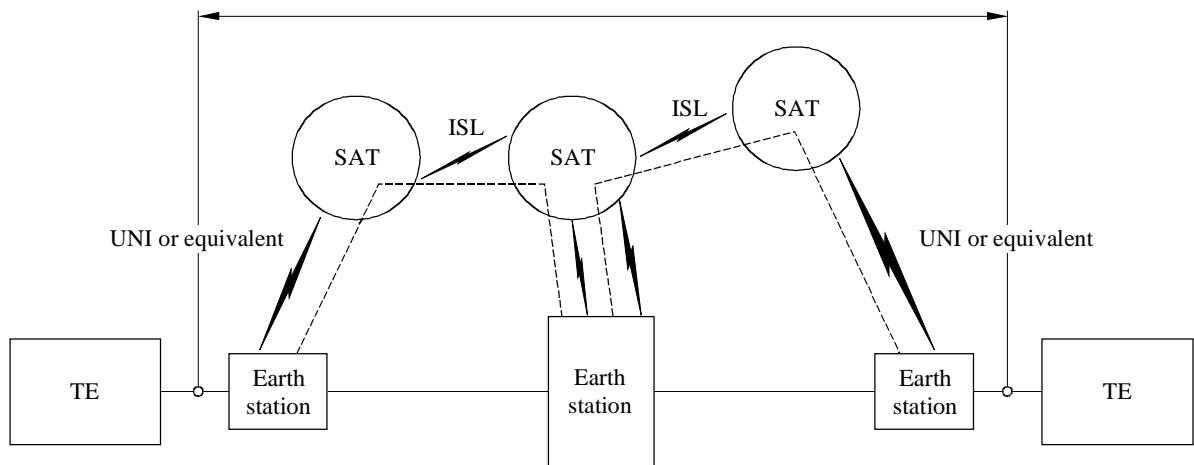
FIGURE 5
Satellite HRDP
 (no connection to the terrestrial network)



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Figure 6 describes a HRDP which includes a space-to-Earth and an Earth-to-space link to an intermediate earth station for further processing, but the HRDP does not connect to the terrestrial network.

FIGURE 6
Satellite HRDP
 (with intermediate earth station)



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